Metacognitive Management for Business Process Change(ビジネスプロセス改善のためのメタ認知的マネージメントに関する研究)

	たいら えりこ
氏名　（本籍）	平　恵理子　　（兵庫県）
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論文審査委員	（主査） 東北大学教授　国分　振　　東北大学教授　加藤　孝義 東北大学教授　鈴木　篤　　東北大学教授　輪田　稔

論　文　内　容　要　旨

Part I Purpose

Chapter 1 Purpose of the Study

Many organizations have been experiencing Business Process Reengineering, which is the novel and radical change for organizations and their employees. In these changes, employees are asked to change their works and behaviors without adequate understanding and agreement in most cases. The author has worked on several new projects requiring the behavioral changes for a global corporation, and realized the importance of metacognitive function for effective and satisfactory implementation. The purpose of this study is to develop the model to explain this metacognitive function, and the system applicable to business settings.

Part II Theoretical Background

Chapter 2 Business Situational Review

The globalization of business causes many changes in the business environment and in business practices. Three major changes and their influences that author has experienced are discussed. The first one is expected capabilities expected for employees because the leverage of corporate capabilities around the world is important for global corporations. The second change is that global excellent companies are always seeking for global standards since more global information is available now by information technology. Organizations have to have the change-oriented culture to support the change to best practices to be competitive. The third change is derived from ERP implementation. ERP is expected to help achieving the global, flexible and responsive management by integrally managing all through the major Business Processes. Although ERP is IT-driven initiative, critical success factors are mindset change and organizational learning due to the required organizational changes.

Chapter 3 Business Process Reengineering

BPR is defined as an organizational initiative to design Business Processes to achieve significant improvement in performance through changes in the relationship between management, information, technology, organizational structure, and people. Two key aspects of BPR that had a significant impact to organizations, are change of work style from functions to work flows, and the utilization of IT. As first few success stories spread, reengineering became a vast global business movement in 1990s. However,

many unsatisfactory results were reported after that. This dissatisfaction has tended to strengthen people's suspicious of IT. Also IT part of implementation was very much focused, implementation of "people-side" factors were often neglected.

Chapter 4 Change Management

It will be much more effective if we approach change as a manageable process with definite structure and outcomes that can be reliably anticipated. Change Management added a great value by defining the resistance, which has never perceived as the logical consequence of the Change initiative. The most difficult aspect of resistance is that people expressed resistance either overtly or covertly. The mechanism to surface and interpret the resistance is necessary.

In terms of organizational learning, it is critical to find and develop advocates for the Change Initiative. The author classified the population into four categories by comprehension and by agreement, one of those is advocates, who do understand and agree with the Change initiative. Significant change within a target population will not occur without sufficient commitment demonstrated by appropriate advocates.

Change Management Process is also reviewed, that was adopted by the company the author belongs to. There are eight sub-processes; identify the change, create the plan, develop advocates, start organizational learning, implement change plan, maintain the change, evaluation and continuous improvement, and identify the next change.

Chapter 5 Metacognition

After J.Flavell defined the concept of "Metacognition" as knowledge of knowledge, this theoretical framework has been applied to developmental and educational field and to neuropsychology. Metacognition gave the interpretive framework and practical strategies. However, it has not been applied to business settings, probably due to lacks of modeling for application and practical tools. Nelson and Narens formulated the model of metacognition, which led the new approaches. It becomes more experimental in Systems Approaches and also becomes structured in concept. In this model, two critical features are needed. The first is the splitting of cognitive processes into two or more specifically interrelated levels. The second is metacognitive system is also a kind of dominance relation, defined in terms of the direction of the flow of information. This flow gives rise to a distinction between "control" and "monitoring".

Part III Metacognitive Facilitation System

Chapter 6 Definition of Metacognitive Facilitation System

The function of metacognition should be considered in solving complex problems or in adapting complex Change initiatives in organizational settings. The author proposed Metacognitive Facilitation System to help these processes.

Although Flavell has suggested that the concept of metacognition might lead us to understand how adults make wise and thoughtful decisions about difficult problems, just having metacognition will not be sufficient to achieve the goal, especially when facing with complex problems. Metacognition always exist, but it should be more 'conscious.' In this paper, 'metacognitive' is defined as having or experiencing 'conscious' metacognition of one's own cognitive processes. 'Facilitation' is to promote and to support people for achieving the goal. Combined with above two definitions, 'metacognitive facilitation' is defined as to promote and support having or experiencing 'conscious' metacognition of one's own cognitive processes.

Based on the definition, the author proposed the conceptual model of Metacognitive Facilitation System. Expanding the model of Nelson and Narens, three levels of cognitive processes within oneself is proposed for the modeling purpose. (Fig.6-1) Lx is the object-level, Ly is the meta-level of Lx, and Lz is the meta-level of Ly or the meta-meta-level of Lx. Ly is the meta-level of Lx, and simultaneously acting as the object level of Lz. Other researchers have suggested multilevel idea itself, however, it has never been modeled and explained as the necessary concept for conscious metacognition. This multilevel idea of processing extends to finitely many levels. This three-level model represents these multi-level models. Thus these levels are not the absolute levels, but the relative level.

Lw is 'facilitation model', which is the cognitive model derived from Lx by monitoring, aimed as being a function of facilitation in this Metacognitive Facilitation System. It is important to note that Lw exists outside of own cognitive system. Lw is derived from Lx but not in one's own system, which includes Lx, Ly, and Lz. It is critical for Metacognitive Facilitation System to

determine how to obtain Lw, and how to utilized Lw as a facilitation tool.

Metacognitive Facilitation System can be restated with this model as 'to make Lx changes' more conscious experiences by having conscious metacognition of Ly that is Lz, with the facilitation model Lw. Furthermore, if we consider Metacognitive Facilitation System, as the cycle of Change process, it is possible to monitor changes of Lx by obtaining renewed Lw from changed Lx continuously, when Ly becomes conscious. If we monitor changes Lw over time, it will be a good method to monitor the process of cognitive change. Facilitation model (Lw) plays the critical role of the Metacognitive Facilitation System. Three conditions of Lw are defined. They are externality, formality and independence.

Chapter 7 Structural Modeling to Generate Facilitation Model

There are several alternatives for tools to generate facilitation model to satisfy three conditions discussed in Chapter 6. One of the alternatives is FISM (Fuzzy Interpretive Structural Modeling), the revised version of ISM (Interpretive Structured Modeling) by adding interpretation of Fuzzy sets. There are four major improvements. The first improvement is to assign each element the value of belonging, which are grades of membership function, by considering the elements of fuzzy sets. The second improvement is to give the multiple choice for the relation, which was either 0 or 1 for ISM. The third improvement is to get the multiple structural models by selecting the grades of relation. The fourth one is to reduce the cycles by having the above three improvements.

Part IV Metacognitive Facilitation Management

Chapter 8 Integration into Business Process Change

Metacognitive Facilitation System is incorporated into Change Management for Business Process Change. There are three sub-processes Metacognitive Facilitation System would work effectively. At the sub-process of identification of Change, problem structuring heuristics become decision aides to help people structure problems. Change structuring at the early stage effects significantly on the direction of the overall process. At the stage of development of advocates, it will be used to identify the advocates and to monitor their comprehension. At the stage of evaluation, it is necessary to identify the next Change initiative, thus the qualitative type of measurement by Metacognitive Facilitation System will evoke discussions for further improvement.

Chapter 9 Case Study 1: Measurement of Changes of Facilitation Model at the Sub-process of Evaluation This is the case study to test monitoring changes of Facilitation Model, applied at the sub-process of evaluation for the new global Business Process of Commercialization. Twenty-six subjects participated FISM session before and after the training of commercialization process. Although there are no specific patterns of structures before the training, structures after the training changed into three patterns reflected subjects' cognitions. It means this method can create Facilitation Model (Lw) by monitoring object-level cognition (Lx).

Chapter 10 Case Study 2: Generation of Facilitation Model at the Sub-process of Development of Advocates

This is the case study to test the generation of Facilitation Model according to three conditions described in chapter 6, at the sub-process of development of advocates. Externality is supported because FISM models are the graphical representation of monitored cognition, existing out of one's own cognition. Formality is proved by both methodology and the feedback from the participants. Independence is also achieved by instructions.

Chapter 11 Case Study 3: Identification of the Change

A team was formed to decide the implementation plan for new role of marketing. The team decided the plan by discussion (Ly), and did FISM to get the Facilitation Model (Lw). Then they compared and agreed the plan by amendments. Facilitation model gave a new perspective to participants and contributed to the effective and satisfactory implementation plan.

Chapter 12 Software for Metacognitive Facilitation System

FISM is very interpretive and implicative, however it has the deficit that it requires mathematical knowledge and high computer literacy for the person to operate. When FISM is applied, facilitators have to participate in the meetings, thus self-use type

of the software is demanded. The software design is introduced in this paper. The major improvements are self-use, choices of analytical methods, and the visible comparison between intuitive results and analytical results.

Part V Conclusion and future research

Chapter 13 Conclusion and Next Steps

This chapter is the conclusion. Current business environment, especially significant changes such as BPR require employee's changes of works and behaviors. BPR failure cases suggested the importance of planned organizational learning that is formulated as Change Management. The concept of metacognition was incorporated into Business Process Change.

Metacognitive Facilitation System was conceptualized. The purpose is to promote and support having or experiencing conscious metacognition of one's own cognitive process. By generating facilitation model, which was derived from oneself but made by formal inference, one can have more 'conscious' metacognition by comparing with human reasoning that is also derived from oneself. The key for Metacognitive Facilitation System is to generate facilitation model with the three defined conditions. Methodology was also examined and developed.

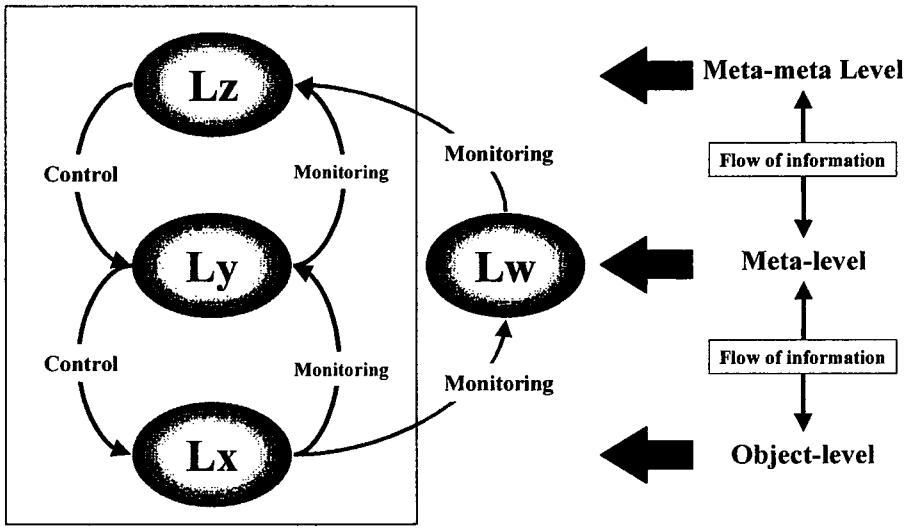

Fig.6-1 Metacognitive Facilitation System

論文審査の結果の要旨

近年、商圏のグローバル化や情報環境の変化に対応するため、多くの企業でビジネスプロセス・リエンジニアリング（BPR）という組織変革手法が適用されている。BPRでは、組織変革の前提として従業員の行動変化を要求するが、この行動変化を促進する取り組みとしてChangeManagement（意識の変化を促進するマネージメント）の必要性が指摘されている。

著者は、ChangeManagementを効果的に導入、実施するための方法論として、メタ認知的支援システム（MFS）を提案した。メタ認知とは、自らの認知をモニターし、コントロールするものとして、認知の一段高いレベルに想定された概念であるが、本論文では、メタ認知に働きかける支援をメタ認知的支援と定義し、メタ認知的支援を可能とする体系として、MFSのモデルを提案している。筆者はさらに、システムの中心的役割を担う支援モデルの条件付け、ならびに支援モデルの生成方法を提案し、実際のビジネス場面への応用を通してシステムの有効性を実証した。本論文は、その研究成果についてまとめたもので、全文13章よりなる。

第1章は序論である。

第2章では、グローバル化によるビジネス環境の変化を、従業員の資質、ベストプラクティス、ERP(EnterpriseResource Planning)導入の観点で考察している。

第3章では、BPRの成功要因として組織的学習の必要性を論じている。

第4章では、ChangeManagementの考察をし、組織的学習を促進するAdvocatesの必要性を論じている。

第5章では、メタ認知の定義、モデルについて述べている。

第6章では、MFSを定義し、そのモデルを提案している。また、MFSの中心的役割を担う支援モデルに、外在性、形式性、独立性という3つの条件を付与し、その生成可能性を示している。MFSは、メタ認知という概念をビジネス分野に応用した点で興味深い成果である。特に、メタ認知をより意識的にするため、形式論理により生成する認知システム外の支援モデルと、人間的推理で得られる認知システム内のメタ認知を、共に自らの認知として比較する手法の提案は、メタ認知的支援の広範な応用可能性を示唆するものとして評価できる。

第7章では、支援モデルを生成する手法について述べている。ISM法にファジー集合論的解釈を加えたFISM法は、支援モデル生成の有力な手法である。

第8章では、ChangeManagementの3つの下位プロセスにおけるMFS適用の意義について述べている。

第9章から第11章は、MFSを適用した事例研究である。支援モデルを生成し、その変化を測定することにより、MFSの有効性を示した。

第12章では、MFSをサポートするソフトウェアについて述べている。

第13章は、結論である。

以上要するに本論文は、組織変革におけるメタ認知機能の有用性を明らかにし、変革を効果的に行うためのメタ認知的支援システムのモデルを提案した。さらに、支援モデルの生成手法、適用事例をもってMFSの重要性を実証したもので、応用心理学、経営工学を含む情報科学の発展に寄与するところが少なくない。

よって、本論文は博士（情報科学）の学位論文として合格と認める。